

EARLY EIGHT-ROWED MAIZE FROM THE MIDDLE RIO GRANDE VALLEY, NEW MEXICO

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A MUTUAL interest of the maize phylogenist (senior author) and the archaeologist (junior authors) in the pre-historic spread of the eight-rowed race of maize, Maíz de Ocho, has made this and several other similar studies possible. Their respective interests, however, lie in different aspects of the same problem. The evolutionary history of Maíz de Ocho involves the origin of the Corn Belt dent as well as many sweet corn varieties and its understanding could lead to the synthesis of even more productive strains in the future. It is an archaeological artifact of certain Indian cultures. The distribution of this race may also reveal some of the history of its possessors.

In an earlier study it was found that the dates for this

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eight-rowed race generally became older toward the Southwest (Galinat and Gunnerson, 1963). A continuity in its distribution between the Plains and the Southwest was established by the discovery of sites for Maíz de Ocho in Chacuaco Canyon in southeastern Colorado (Galinat and Campbell, 1967). The date of A.D. 1140 for this Colorado material leaves unsolved the problem on direction of spread because now the slightly older dates of A.D. 1040 have been discovered for this race at the Blain Site in Ohio (Galinat, 1969) and of A.D. 1125 ± 70 at the Miller Site in Ontario (Kenyon, 1968).

Documentation of the spread of Maíz de Ocho, like that of other cultural artifacts, depends upon the discovery of its oldest possible remains at certain critical locations. The present report on the oldest Maíz de Ocho yet discovered in North America has, therefore, particular significance in revealing the spread of this race of maize.

The radiocarbon dates herein reported were determined gratuitously by Dr. Henry F. Nelson of the Research Laboratory of the Mobil Oil Corporation, Dallas, Texas. The date of 18 ± 138 B.C. (SM 1021) at the BR-45 Site came from an indirect association in debris between some wood and the cobs of Maíz de Ocho. The shallow and homogeneous nature of this debris seems to rule out any significant disparity between the age of the cobs and that of the analyzed wood. The more recent date of A.D. 370 ± 168 (SM 1018) at Boca Negra Cave for this eight-rowed race came from wood which was charred in the same hearth with the cobs. At the third location for Maíz de Ocho discussed here, the Artificial Leg Sites, the dates of A.D. 550 to A.D. 700 for the cobs of this race were determined by combining data from ceramic analysis, palynology and archaeomagnetism (Frisbie, 1957).

THE LOCATIONS AND CULTURAL PHASES OF THE SITES

THE BR-45 SITE

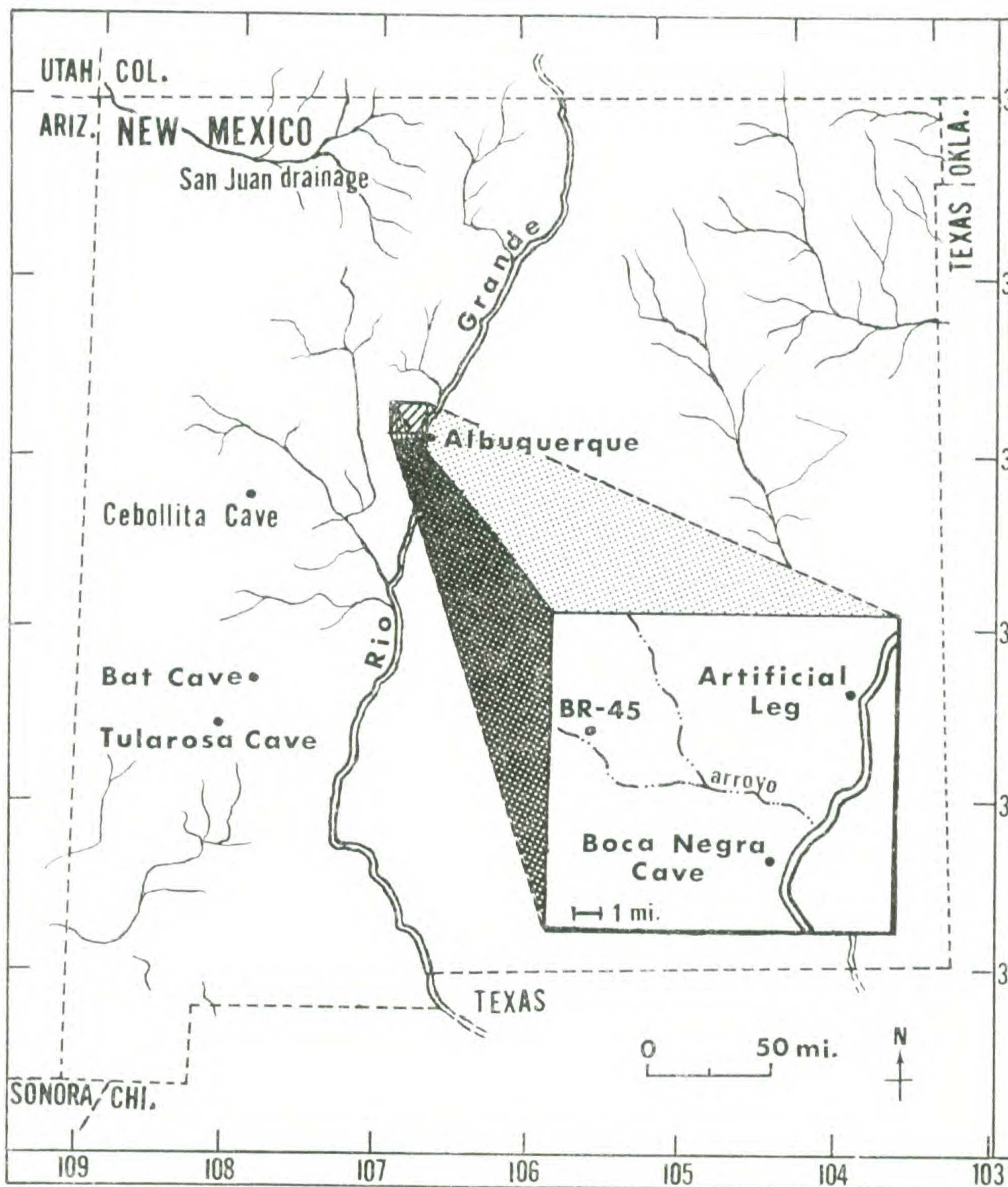
The BR-45 Site is located on the west mesa at 6100 feet about $12\frac{1}{2}$ miles west of the Rio Grande River at Albuquerque, New Mexico, while the Boca Negra Cave and Artificial Leg Sites are elevated at about 5100 feet on the first terrace closer to the river. The other maize-containing sites previously reported in central New Mexico are on the same western side of the river and to the southwest of the Middle Rio Grande Valley (Plate LXXIX).

The west mesa is now dissected by arroyos sloping in a west-to-east direction toward the river. The arroyos cut through dune-covered ridges which were the occupation sites. During a number of wetter years than at present, maize was probably grown on the flood plains where these more modern arroyos now occur.

The BR-45 Site occupies the south slope of one of the sandy ridges just below its crest. It consists of two small pithouses with outside living areas to the east of the dwellings, as described in detail by Reinhart (1967a).

The cultural affinities at the BR-45 Site were of the Alameda Phase which is an early Basketmaker III manifestation. Its identification is based on typological comparisons, including ceramics, to known Basketmaker III material. These identifications (Reinhart, 1967a) suggest that the dunes were stabilized approximately 2000 to 1500 years ago during a period of increased moisture. This dating also appears to fit the moist period postulated as being between the Fairbank and Whitewater droughts (Antevs, 1955) as well as the radiocarbon date of 18 ± 138 B.C. for the BR-45 maize, as will be described later.

PLATE LXXIX



The enlarged insert shows the three site areas, BR-45, Boca Negra Cave, and Artificial Leg, which are studied in this paper. Other maize-containing sites in New Mexico are indicated to the southwest of this Albuquerque area.

BOCA NEGRA CAVE

Boca Negra Cave is situated on the northeast side of a volcanic cone near the city of Albuquerque. The cave measured $27\frac{1}{2}$ feet deep, $20\frac{1}{2}$ feet wide and 6 feet high before excavation. The details of the excavations are described by Reinhart (1968).

Because the terrain around the cave and for a mile to the river is rocky and otherwise unsuited for agriculture, the site probably never had a permanent agricultural settlement. Nevertheless a long record of maize and other artifacts was left apparently by migrants who camped at the cave for a short time and then moved to other Basketmaker III agricultural sites along the river such as those at Artificial Leg.

The stratigraphy at Boca Negra Cave has a bearing on our understanding of the evolution of southwestern maize. Its succession includes material which is both older at the lower level and more recent at the upper level than that found at the BR-45 Site. The earliest culture present was of the late Atrisco Phase (Campbell and Ellis, 1952) which dates prior to 1000 B.C. and is a local Cochise manifestation. While incipient agriculture may have been practiced, there is no direct evidence of it either at Boca Negra Cave or at the west mesa sites at this early time. The Atrisco Phase is preceramic and is represented here only by lithic tools. While the next Phase, Rio Rancho, was also preceramic, it contained cobs of Chapalote, the indigenous race of the Southwest and Mexico which will be described later. Both the ceramics and a new race of maize, Maíz de Ocho, appear in the Alameda Phase, an early Basketmaker III culture dated at A.D. 370 ± 168 at the Boca Negra Cave Site. This stratigraphy extending over a 3000 year period together with the racial identity of the maize present are given in Table III.

THE ARTIFICIAL LEG SITES

The three excavated Artificial Leg Sites are also located near the river about 12 miles north of Boca Negra Cave and just to the west of Sandoval (Corrales), New Mexico (Frisbie, 1967). The initial settlement of Site I occurred during the same drought period around A.D. 550 when Maíz de Ocho was introduced into the already established culture of Boca Negra Cave. The settlers at Artificial Leg also appear to have migrated from their original home on the mesa (BR-45) to these sites near the river in order to have moist soil necessary for the growth of their maize.

The shelters at these Middle Rio Grande Valley sites were pithouses. Their structure coincides more closely with that of the Mogollon custom in the South than with that of the Anasazi of the North. They were nearly circular in outline with either a flattened or concave east side. The roofs were usually supported by four posts. Floor features consisted of a centrally located, circular, collared hearth, deflectors, ash pit, ladder holes, and an easterly oriented ventilator shaft. Other floor features included depressions and storage pits, many widened at their bases.

At Artificial Leg, each site consisted of a group of at least four such pithouses. One of these structures was larger than the others, being 26 feet in diameter rather than the approximately 16 feet commonly found. This larger pithouse, more properly termed "kiva," served ceremonial purposes, as indicated by its *sipapu* or "opening to the underworld," by its foot drums and by its location apart from the other pithouses. The development of these ceremonial structures again reflects Mogollon customs.

The appearance of the new productive races of maize,

Maíz de Ocho and Pima Papago, with the Mogollon type of pithouse, especially the ceremonial type, indicates that the two may have diffused together from the South. The short tenure of these races on the mesa which was terminated by drought may not have allowed time for the elaboration of appropriate ceremonialism.

The evidence from ceramics at these sites near the river indicates contacts with both the southern and northern cultures. Potsherds from the Alma Plain which originated with the Mogollons from the South were found with mineral and carbon painted affiliates of Lino Gray representing Anasazi wares from the North. While the data on ceramics do not in themselves verify the route of Maíz de Ocho, they do reveal that trade was well established between the South and North. This new race of maize would probably have been included in some of the transactions.

THE MAIZE

Chapalote is the indigenous race of maize of the area. It traces back to preceramic times during the Rio Rancho phase at Boca Negra Cave. About 125 miles to the south at Bat Cave, New Mexico, Chapalote was dated at 2300 B.C. where its evolution eventually involved a second element, the wild relative teosinte, at 500 B.C. (Mangelsdorf and Smith, 1949; Mangelsdorf et al., 1967).

Chapalote may be identified either by its kernels or by its cobs. Its kernels are deeper than wide in shape and generally small and flinty although a floury form was selected in Basketmaker times. Its cupules (depressions in the cob axis (rachis) immediately above the attachment point of each pair of pistillate spikelets) are narrow (3 to 4 mm. wide) and the width and height (internode length) are usually of about equal dimensions. Evolved Chapalote has 12 to 16 rows of kernels while the earliest

TABLE 1.
MAIZE FROM THE BR-45 SITE, NEW MEXICO

Sample Number	No. Kernel Rows	w=Cupule Width(mm)	ℓ =Internode Length(mm)	Cupule Shape w/ ℓ	Race
BR-45/M1-1	12*	5.6	3.5	1.6	Pima Papago
" -2	12	5.3	3.2	1.7	" "
" -3	12	5.4	3.5	1.5	" "
" -4	12	5.6	3.6	1.6	" "
BR-45/M2	8*	6.0	3.0	2.0	Maíz de Ocho

*Row number estimated on the basis of cob fragments consisting of at least two parallel rows of cupules.

w/ ℓ = cupule width/cupule internode length.

Chapalote, such as that from Bat Cave, has eight kernel rows. The race Reventador is very similar to evolved Chapalote except for having colorless instead of brown pericarp. Because no distinction between Reventador and Chapalote was possible in this archaeological material, the name of the older race, Chapalote, is used.

The race of particular concern, Maíz de Ocho, was the third major element involved in the evolution of maize in the Southwest. Previously this race was thought to have arrived in New Mexico at about A.D. 700, the date of its earliest remains at Tularosa Cave (Cutler, 1952). Apparently it appeared at about the same time 90 miles northward at Cebollita Cave (Plate 23 F of Galinat and Ruppé, 1961). The earlier dates of 18 ± 138 B.C. for Maíz de Ocho 75 miles to the northeast at BR-45 and A.D. 370 ± 168 at Boca Negra Cave do not negate the overall evidence for a southern origin. The next oldest date for this race is A.D. 200–850 previously reported for a site in Tamaulipas, Mexico (Mangelsdorf et al., 1967). The Tamaulipas material may be on a parallel pathway leading to the Davis Site in Texas which had this eight-rowed race at A.D. 800–1000 (Jones, 1949). The Maíz de Ocho ancestral to that from the Albuquerque area of New Mexico more probably came directly through Chihuahua and Sonora, as indicated by four caves in these Mexican states yielding prehistoric remains of this race (Mangelsdorf and Lister, 1956). Apparently southern United States had multiple connections through the Sierra Madre Occidental of northern Mexico from some common source, perhaps on the west coast of southern Mexico. Maíz de Ocho is thought to have been derived originally from Colombia, South America (Galinat and Gunnerson, 1963).

The kernels and cob of Maíz de Ocho are distinctive from those of Chapalote. They occur in only eight rows

(borne in pairs at four ranks of cupules) instead of the 12 to 16 rows which characterize the older race. The shape of kernel is also different, being wider than deep rather than deeper than wide. In addition, the shape of the cupule is definitive. The ratio of cupule width/internode length is about two in Maíz de Ocho in contrast to the more narrow cupules of Chapalote, especially near the tip of the cob where the ratio is close to one.

THE MAIZE FROM THE BR-45 SITE

The maize from BR-45 consisted of five broken and eroded cobs. The kernel row number, cupule width and internode length of these specimens was measured in order to establish their racial identity (Table I). One of the cobs represented the race Maíz de Ocho and the other four were from its hybrid, Pima Papago. The eight-rowed cob could be a segregate out of the hybrid. In any case the hybrid was most abundant. The early acceptance of the hybrid may be due to its rapid adaptation through the segregation of favorable genes from its indigenous parent, Chapalote. The increased vigor and productivity associated with such a wide cross must have promoted its spread, probably far ahead of the Maíz de Ocho parent.

The cultivation of the productive races of maize, Maíz de Ocho and Pima Papago by the people at BR-45 seems to have bound their way of life to farming. Serving these people as a major source of food, they became dependent upon it. Subsequently after a protracted dry period they abandoned the mesa for sites nearer the river which provided the moist soil necessary for the growth of their maize. After abandonment, the cobs of Maíz de Ocho and Pima Papago and other debris on the ridge sites became buried under the sands of time until the present excavation. Previously when their ancestors with

TABLE II.

MAIZE FROM BOCA NEGRA CAVE, NEW MEXICO

Sample	No. Kernel Rows	Cupule Width(mm)	Internode Length(mm)	Cupule Shape w/l	Race
BB-1/M1-1	12	3.5	3.5	1.0	Chapalote
" -2	12	4.0	2.8	1.4	Chapalote Mix
" -3	12	5.0	3.2	1.6	Chapalote Mix
" -4	12	3.5	3.5	1.0	Chapalote
BB-1/M2	10	6.5	3.0	2.2	Maíz de Ocho
BB-1/M3	12	4.6	3.0	1.5	Maíz de Ocho Mix
BB-1/M4-1	10	6.5	3.7	1.8	Maíz de Ocho
" -2	14	9.5	5.3	1.8	Pima Papago
BB-1/M5-1	c. 10	5.0	3.6	1.4	Maíz de Ocho Mix
" -2	c. 10	5.5	3.5	1.6	Maíz de Ocho Mix
BB-1/M6-1	c. 10*	5.7	4.2	1.4	Maíz de Ocho Mix
" -2	c. 8	5.4	4.0	1.1	Maíz de Ocho Mix
" -3	c. 8	5.6	4.1	1.4	Maíz de Ocho Mix
" -4	c. 8	5.5	4.1	1.3	Maíz de Ocho Mix
BB-1/M7-1	12	4.6	4.0	1.2	Chapalote Mix
" -2	12	3.1	3.1	1.0	Chapalote
" -3	12	3.2	3.2	1.0	Chapalote
BB-1/M8-1	c. 12	3.5	3.5	1.0	Chapalote
" -2	c. 12	3.4	3.5	0.97	Chapalote
"	c. 12	3.1	3.3	0.94	Chapalote
BB-1/M9-1	c. 10*	6.5	2.6	2.5	Maíz de Ocho
" -2	c. 12*	7.3	3.0	2.4	Pima Papago
" -3	c. 10*	6.0	3.3	1.8	Maíz de Ocho
" -4	c. 12*	5.3	3.6	1.5	Pima Papago
BB-1/M10-1	c. 10	6.7	4.2	1.6	Maíz de Ocho Mix
" -2	c. 6	8.1	4.6	1.8	Maíz de Ocho Mix
BB-1/M11	c. 14	4.5	4.5	1.0	Chapalote

*Row number estimated on a basis of fragments consisting of at least two parallel rows of cupules.

c. - carbonized cob.

less productive food plants encountered similar drought conditions on the mesa, they merely adapted by shifting their subsistence patterns to include more wild food rather than seek a more suitable farming area.

The early radiocarbon date (18 ± 138 B.C.) and the major cultural traits at BR-45 indicate that the races of maize, Maíz de Ocho and Pima Papago, located there were originally derived from the southern Mogollon culture rather than from the Anasazi of the San Juan drainage area to the North. That is, the age of the Basketmaker cultural level at BR-45 and the other nearby sites discussed in this paper is intermediate between that of the older Mogollon cultures of the South and the more recent San Juan cultures of the North. This suggests that the Middle Rio Grande Valley was an area of transition from South to North.

THE MAIZE FROM BOCA NEGRA CAVE

Before the introduction of Maíz de Ocho, the indigenous race of maize, Chapalote, occurred in Basketmaker II (preceramic) times about twelve miles away toward the river at Boca Negra Cave. Later the people presumably moving from the drying mesa area (BR-45) left their Maíz de Ocho and Pima Papago maize during the early Basketmaker III period (the end of the Alameda Phase). The radiocarbon date of A.D. 370 ± 168 for this new maize at the cave is a jump of over 400 years over that reported for its collection at BR-45, only $12\frac{1}{2}$ miles away but 1000 feet higher on the west mesa.

There were 24 eroded cobs, eight of which had been carbonized, from Boca Negra Cave. The excavation was in stratigraphic layers from the surface to a depth of 40 inches. The cobs represent two distinct races, Chapalote and Maíz de Ocho and their hybrid, Pima Papago, as well as some intermediate types classified as "mixed"

TABLE III

THE STRATIGRAPHY AND MAIZE FROM BOCA NEGRA CAVE						
Phase of Cultural Association	Maize Sample Number BB-1	Race of Maize				
		Chapalote	Chap. mix.	Pima Papago	M. de O. mix.	Maíz de Ocho
Pueblo IV to Historic	M1	2	2	0	0	0
Pueblo IV	M2	0	0	0	0	1
Pueblo III to IV	M3	0	0	0	1	0
Pueblo II to IV	M4	0	0	1	0	1
Early Alameda ¹	M9	0	0	2	0	2
Rio Rancho to Alameda	M5	0	0	0	2	0
" " " "	M6	0	0	0	4	0
Rio Rancho to Early Alameda	M8	3	0	0	0	0
Rio Rancho ²	M7	2	1	0	0	0
Atrisco ³	-	0	0	0	0	0

1 - Early Basketmaker III, dated A.D. 370 \pm 168

2 - Basketmaker II, preceramic

3 - Local Cochise, no direct evidence for agriculture prior to 1000 B.C.

Two additional maize samples (BB-1/M10 and BB-1/M11) of unknown cultural association are not included.

which probably represent the backcross or segregating progenies derived from the hybrid. The typical hybrid type (Pima Papago) combined the higher kernel row number (12 rows) of Chapalote with the wider cupules (6 to 10 mm.) of Maíz de Ocho. When the mixed modification is toward Maíz de Ocho, the specimen is scored as Maíz de Ocho Mix. When the direction is that of Chapalote, it is identified as Chapalote Mix. The data upon which the races and forms were identified and the phase of cultural association for the various specimens are given in Tables II and III.

THE MAIZE FROM THE ARTIFICIAL LEG SITES

All of the 13 cob fragments of maize from the Artificial Leg Sites were completely carbonized. Ten of these came from Site I dated at A.D. 550 to A.D. 700, two from Site II dated at A.D. 750 to A.D. 800, and one from Site III dated at A.D. 870 to A.D. 930. The hybrid race, Pima Papago, predominates and the larger collection (Site I) contains a few specimens similar to its parents, Chapalote and Maíz de Ocho. The latter appear to be parental-type segregates from the hybrid rather than independently derived pure entities (Table IV).

Pima Papago is presumed to have been more successful at first than its introduced parent, Maíz de Ocho and, thereby, to have traveled northward from the Sierra Madre Occidental at a faster pace. It is unfortunate that more specimens were not available from Site III. The single specimen available was of a modified form of Maíz de Ocho which may well represent a segregate from the hybrid.

Apparently in the more northerly climates natural selection favors the eight-rowed derivatives. Further north across the boundary into southeastern Colorado, the Chapalote type segregates almost disappear while

TABLE IV
MAIZE FROM THREE SITES AT ARTIFICAL LEG, NEW MEXICO

Sample Number	No. Kernel Rows	Cupule Width(mm)	Internode Length(mm)	Cupule Shape w/l	Race

Site I, Pithouse 6, West Cist Floor: A.D. 550 to A.D. 700

BAL-35/1	14	6.9	3.0	2.30	Pima Papago
" 35/2	12	5.9	3.0	1.96	Pima Papago
" 35/3	12	4.5	3.2	1.43	Chapalote
" 35/4	8	10.0	3.2	3.10	Maíz de Ocho
" 35/5	12	5.1	3.5	1.46	Pima Papago
" 35/6	14	4.8	3.4	1.41	Chapalote Mix
" 35/7	10	5.2	3.6	1.45	Pima Papago
" 35/8	14	3.8	2.0	1.90	Pima Papago
" 35/9	16	5.9	3.0	1.97	Pima Papago
" 35/10	12	4.9	3.1	1.58	Chapalote

Site II, Pithouse 4, Fill: A.D. 750 to A.D. 800

BAL-35/11	12	5.5	3.5	1.57	Pima Papago
" 25/12	14	5.7	3.7	1.54	Pima Papago

Site III, Pithouse 1, Fill: A.D. 870 to A.D. 930

BAL-35/13	10	6.1	2.7	2.26	Maíz de Ocho Mix
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Maíz de Ocho germplasm predominates. Here in the Chacuaco Canyon area, Chapalote was reduced to only two percent while Maíz de Ocho occurred at 22.8 percent, Maíz de Ocho Mix at 36.9 percent and the intermediate hybrid type (Pima Papago) at 36.3 percent from a total of 201 cobs (Galinat and Campbell, 1967). As the distribution progressed onto the Plains and north-eastward, the frequency of pure Maíz de Ocho increased. Nevertheless, even the northern flints may exhibit some degree of Chapalote germplasm derived from their ancestral mixing in the Southwest such as is manifest by the flinty kernels or the occasional kernel row numbers of over eight.

SUMMARY

The radiocarbon date of 18 ± 138 B.C. is the earliest North American date yet reported for the introduced race of maize, Maíz de Ocho, or its hybrid, Pima Papago, involving the indigenous race, Chapalote. The early date comes from the BR-45 Site about $12\frac{1}{2}$ miles to the west and 1000 feet higher than the Albuquerque area of the Middle Rio Grande Valley, New Mexico. Older remains of the original pure form of Maíz de Ocho probably will be discovered in Chihuahua and Sonora, perhaps near the valleys draining to the west coast of Mexico. From there, it is presumed to trace to South America where it has botanical affinities with the Colombian race, Cabuya (Roberts et al., 1957). The early presence of the hybrid Pima Papago in New Mexico rather than the pure Maíz de Ocho parent can be attributed to an increased adaptability, vigor and productivity associated with outcrossing to the indigenous race, Chapalote. The eight-rowed parent remains in a semi-hybrid condition in the form of Harinoso de Ocho in northwestern Mexico (Wellhausen et al., 1952), while it has assorted out to an

increasing pure race as it spread onto the Plains and to the Northeast in its well known forms of northern flour and northern flint. The presumed Colombian ancestor, Cabuya, is a highland race, and this might account for some pre-adaptation to high altitudes and northern latitudes in United States, as exemplified by the early distribution of Maíz de Ocho (Galinat and Gunnerson, 1963).

The Maíz de Ocho from the BR-45 Site was moved by its cultivators to sites with moist soil along the river after a protracted dry period made the mesa unsuitable for the growth of their maize. At the lower elevations, it became further mixed with the older indigenous race, Chapalote, in Basketmaker III times at the end of the Alameda Phase. The radiocarbon date of A.D. 370 ± 168 marks the introduction of this eight-rowed maize into the strata at Boca Negra Cave. A somewhat later date of A.D. 550 to A.D. 700 follows for this race just north of Albuquerque at the Artificial Leg Sites. By A.D. 1040 Maíz de Ocho had reached the Blain Site in Ohio (Galinat, 1969) and by A.D. 1125 ± 70 the Miller Site in Ontario (Kenyon, 1968). While the frequency and purity of Maíz de Ocho increased during its spread to the Northeast, some traits of Chapalote derived from an ancestral mixing in the Southwest may still be recognized in the Canadian and New England flint corn varieties.

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